APPROACHES TO THE ASSESSMENT OF IMPACTS AND ADAPTATIONS

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2.1 Purpose of Assessment

There are several different reasons for conducting a climate impact assessment. First, there is a need to evaluate how climate affects human activities and well-being and natural systems along with estimates of the uncertainties surrounding these effects. The effects may be physical (e.g., on water availability), biological (e.g., on plant growth), economic (e.g., on industrial profitability), social (e.g., on regional employment) or a combination of these. Second, it may assist in evaluating sensitivities, vulnerabilities or thresholds to likely scenarios of climate change and in evaluating potential environmental standards. Third, it can identify and/or evaluate the range of possible options for adapting to and, where possible, exploiting the effects of climate change. Fourth, it can help with the assessment of the costs of impacts of climate change so that these can then be compared with the costs associated with adaptation and mitigation measures in order to assist with the formulation of balanced policy responses. Fifth, it can identify impacts of limitation or adaptation options. Sixth, it can assist in pinpointing gaps in climate research that require attention because of their importance in assessing impacts. Finally, it can alert public awareness to issues of common concern (for example, to educate people about the need for improving the efficiency of resource use) and establish a basis for political decisions.

2.2 Definitions of Some Important Terms

A number of the terms used in this report can have various connotations. To reduce the risk of misinterpretation, some simple definitions are given below. Definitions of other terms are provided elsewhere in the text.

- An **exposure unit** is the activity, group, region or resource exposed to significant climatic variations.
- An **effect** is directly produced by a process or agent (e.g., climate) acting on an exposure unit.
- An **impact** is an effect on the exposure unit having some assigned relative value or importance.
- **Assessment** refers to the scientific appraisal of effects.
- **Evaluation** is the assignment of significance or importance to effects or to alternative strategies.
- **Adaptation** is concerned with responses to the effects or impacts of climate change.
- A **scenario** is a coherent, internally consistent and plausible description of a possible future state of the world.
- **Sensitivity** (in its general sense) refers to the degree of responsiveness of an exposure unit to climate, whether beneficial or detrimental.
- **Vulnerability** is the degree to which an exposure unit is disrupted or adversely affected as a result of climatic effects. Both socio-economic and physical factors are important in determining vulnerability.

2.3 Approaches

Climate impact assessments may be conducted according to one of three general methodological approaches (Kates, 1985): impact, interaction and integrated approaches.

2.3.1 Impact approach

The simplest approach follows a straightforward 'cause and effect' pathway whereby a climatic event acting on an exposure unit has an impact (Figure 1). In layperson's terms it can be thought of as an 'If-Then-What' approach: if the climate were to alter like this then what would be its impacts? In adopting the approach it is assumed that the effect of other non-climatic factors on the exposure unit can be held constant. Where this assumption is justified, (for example, in biological studies of pristine environments not subject to any non-climatic changes), the approach can be informative. However, the narrow focus on the effects of climate alone on human activities is also a major weakness of the approach. Another problem is that the whole assessment is reliant on the initial choice of a climatic event, which is not always selected according to criteria that are relevant to the climate-sensitivity of the exposure unit. Finally, a major drawback of this approach is an inability to assign a likelihood to the assumed changes in climatic factors.

The impact approach is usually adopted for studies of individual activities or organisms in order to establish 'dose-response' functions, but it is also applied to sectoral studies where impacts may propagate through a hierarchy of levels. Thus, direct impacts represent the direct biophysical effects of climate on organisms or activities (e.g., on plants, animals, heating demand, water). The direct effects lead, in turn, to indirect impacts (e.g., changes in grass growth leading to changes in livestock productivity). The chain of impacts may then extend to higher-order economic and social impacts (e.g., changes in farm income, changes in national agricultural production, changes in farm employment).

In order to follow this hierarchical approach assumptions are required at each level of analysis. Inevitably, accompanying these assumptions are uncertainties, which may themselves propagate through the system. Given the large uncertainties, the exclusion of other influencing factors and the lack of consideration of possible feedback effects, it is rare that such a formal methodology can be followed successfully in impact assessment. More commonly an integrated or partially integrated approach must be adopted (see 2.3.3).

Figure 1. Schema of the impact approach (after Kates, 1985)

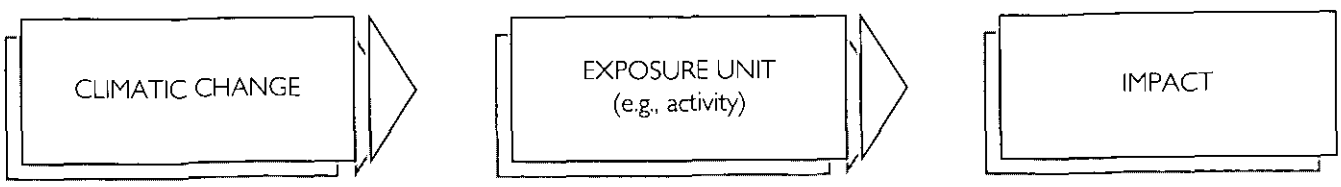
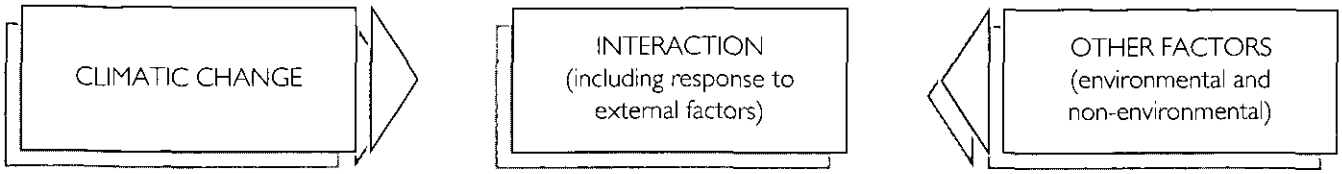


Figure 2. Schema of the interaction approach (after Parry and Carter, 1988)



2.3.2 Interaction approach

The interaction approach recognizes that climate is only one of a set of factors that influence or are influenced by the exposure unit (Figure 2). For instance, the effects of an equivalent shortfall of rainfall may be felt quite differently in different parts of the world, some experiencing hunger or malnutrition due to underlying factors such as poverty, war or social marginalization, others profiting from increased food prices at a time of general shortage. Only if these other factors are fully accounted for will an accurate evaluation of the effects be achieved.

The interaction approach also allows for feedbacks that may regulate or enhance an effect. To illustrate a simple feedback at a global level: a change in climate may lead to a shift in natural vegetation zones. However, this shift in zones may itself influence the climate through changes in fluxes of gases to and from the atmosphere, and through changes in surface reflectivity.

A study method that fits closely into the structure of the interaction approach is the adjoint method (Parry and Carter, 1988; Parry, 1990). In simple terms this can be thought of as a 'What-Then-If' approach: What points of a system are sensitive to what types of climatic change and then what might the impacts be if those changes in climate were to occur? It differs from the impact approach, described above, in that the climate event is selected according to the climate-sensitivity of the exposure unit.

2.3.3 Integrated approach

An integrated approach is the most comprehensive treatment of the interactions of climate and society. It seeks to encompass the hierarchies of interactions that occur within sectors, interactions between sectors, and feedbacks, including adaptation, which serves to modify impacts and scenarios alike (Figure 3). In practice, since the knowledge base is insufficient to envisage conducting fully integrated assessments, only partially integrated assessments are feasible. These can be achieved by linking together parallel studies for different sectors in the same region (usually a nation or large administrative unit). This approach is being implemented in an

Figure 3. An integrated approach to climate impact and adaptation assessment (Modified from Parry and Carter, 1988)